

## **Global Competition and Its Effects on U.S. Manufacturing Industry**

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### Abstract

This paper discusses the global competition and its effects on U.S. manufacturing companies and consumers. In order to compete effectively in the highly competitive global market, American firms must strive to produce high-quality products at low cost and with short lead times, while providing outstanding customer service. Some leading U.S. based companies such as Boeing have recently integrated latest technological innovations (IPTeam software by Nexprise, Inc) into their product development with great success. The results of a survey and the role of Concurrent Engineering and latest technological innovations in enhancing U.S. competitiveness in the world market are also presented.

### I. Introduction

The competitive and intense manufacturing market and global economic recession have prompted many manufacturing companies to re-evaluate and reconstruct the process they undertake to design and manufacture a new product. Rapid changes in technology are changing the basis of competition throughout the world. Weakness in design and manufacturing capabilities in U.S. firms is often cited as a major factor in decline of their international competitiveness<sup>1</sup>. American companies not only have to compete with their traditional Japanese and European counterparts, but with a surge of the newly industrialized countries (NICs) such as China, Korea, Taiwan, and Malaysia. In order to compete effectively, American firms must strive to produce high-quality products at low cost and with short lead times, while providing outstanding customer service. They also must be able to deal with shorter product life cycles.

As the American manufacturing companies become more aware of their weakness, they are devoting attention to the process by which they define customer needs and product performance. They plan concurrently for design and manufacturing with full consideration of the entire product life cycle, including distribution, support, and maintenance. Some leading U.S. based companies such as Boeing have recently integrated latest technological innovations (IPTeam software by Nexprise) into their product development with great success.

The objective of this paper is to discuss the effects of global competition on U.S. manufacturing companies and what they are doing to maintain their international competitive edge. This paper is organized as follows. In the next section, we discuss American-made products versus foreign-made products and related surveys. We then present the problems that U.S. manufacturing companies are facing in their global competition. Next, we discuss some methodologies and innovative technologies that are being embraced and employed to help U.S. manufacturing to remain competitive in the global market. We then examine one such advanced technology

entitled “IPTeam Suite,” by Nexprise, Inc, which is starting to become widely used by the industry. This software has been used by industry for team collaboration in an asynchronous mode over the Internet. The software has enabled companies to out-source their work to suppliers and subcontractors and compete more effectively in the global economy. However, this software is relatively new to the academia. We then present a pilot project between East Tennessee State University (ETSU), Loyola Marymount University (LMU) in Los Angeles, CA, and our industrial consultant. The IPTeam Suite was used in a new product development course where the students from the two universities have interacted in teams of joint projects. We conclude with some discussions from our own experience with IPTeam Suite software and the pilot project.

## II. American-Made Products versus Foreign-Made Products

Economic necessity has forced an increasing number of American consumers to purchase imported products. A recent survey of distribution outlets indicates that the market is flooded with products from NICS<sup>2</sup>. These products range from non-essential items, such as office supplies, to expensive high-tech electronic devices, such as television sets and VCRs. Great effort is needed to compete with this flood of imports. U.S. manufacturers once relied on the higher quality of their products to compete with lower prices and lower quality products from the NICs. However, the successes of the NICs in increasing market share indicate that the quality of their product has been improved in recent years, while their costs have been reduced. Although American firms now lead in most world markets, they still lag behind, with respect to the ability to design, manufacture, and market technologically inventive products<sup>3</sup>.

U.S. manufacturers must produce better products with shorter lead times and improved quality, and at lower cost. American firms keenly realize, because of the fierce competition, that value-conscious customers will search for better products at lower prices from available sources. A joint survey conducted by the Gallop Organization and the International Mass Retail Organization showed that only 27 percent of respondents considered the country of origin as an important factor when they shop. Those polled listed more than one characteristic as “extremely important:” 82 percent cited quality, 57 percent said product features, and 53 percent stated prices and warranty<sup>4</sup>. In the next section we discuss some of the problems facing American industry.

## III. Problems Facing U.S. Manufacturing Companies

An increasing number of discontinued products, especially in recent years, are evidence that companies often fail in addressing consumer complaints in cost-effective ways. Some products ranging from toys to automobiles, are so poorly designed and manufactured that they are rendered unsafe, with the result that recalls are issued by various Federal agencies and the Consumer Product Safety Commission. These recalls erode consumer confidence in the manufacturers, and consumers are more likely to seek other sources for their future needs<sup>4</sup>.

Another major problem encountered by many manufacturing firms is a long lead-time to develop a product. Even if the company is successful in designing a high-quality product at low cost, the product is either introduced into the market too late or it fails to meet the market’s requirements at that time. Manufacturing firms gradually recognized these problems and a need for change, if they were to increase their market share and gain the confidence of their prospective customers.<sup>5,6</sup> They have been trying to employ a variety of available tools and methodologies,

from graphical to mathematical, in their quest for designing better products. Their successes have been limited. Various nonprofit organizations such as the Consumer Union regularly evaluate and rate products based on many categories such as quality, reliability, and consumer satisfaction. They have given higher marks to American-made products in recent years, yet in a majority of cases they recommend imported products mainly because of lower prices. The reason is obvious. The high standard of living in the U.S., which has resulted in well-paid workers from assembly-line operators to top executives, drives up the cost of a product until it is out of reach for many economically-strapped consumers.<sup>4</sup>

Unfortunately, a large number of American corporations, rather than directing their resources toward finding a cost-effective way to produce products at home, simply have been closing down factories here and relocating their operations to overseas plants. This process has not only been weakening the economy and raising the unemployment rate, but also causing resentment among the workers who are adversely affected. These companies usually justify their decision by pointing out the fact that much lower labor rates and lax regulations in foreign countries make it unprofitable for them to continue business at home. The U.S. counterpart, Japan, has also moved some of its operations overseas because of lower labor rates. However, in recent years U.S. companies had more success in competing globally by employing various methodologies and embracing latest technological innovations. Some of these methodologies and cutting edge technologies are explained next.

#### IV. Concurrent Engineering

In order to meet the consumer's requirements and remain competitive internationally, an increasing number of U.S. companies are abandoning once dominant conventional engineering or over-the-fence practices that are largely sequential. These companies are increasingly embracing the principles of task-oriented Concurrent Engineering (CE) to overcome the costly and time-consuming difficulties of traditional product development methods. This trend of breaking away from traditional approaches was initiated over a decade ago with the introduction of several concepts or logistics such as Flexible Manufacturing Systems (FMS), Computer-Aided Design and Manufacturing (CAD/CAM), Computer Integrated Manufacturing (CIM), Quality Function Deployment (QFD), and Just in Time (JIT). These concepts and others were rapidly thrust onto engineering firms by consultants, to assist them in designing and manufacturing high-quality products at lower costs and in time to meet market demands.

Many researchers have been promoting the idea that some of these concepts could be incorporated and utilized within a CE environment. There is little doubt that companies which fail to adopt the principles of CE will be forced out of business in the competitive manufacturing market. Satisfying customers' demands and meeting their expectations are the core of the CE concept. Although many U.S. companies have adopted the CE philosophy in their product development process, implementation has not been easy and some problems remain. For instance, some of these companies focused only on the organizational aspects of CE, by simply grouping together personnel who had previously been allocated in separate departments. While others have focused in integrated systems to share a product model. Because of this narrow focus, the full potential of CE has not yet been fully explored<sup>5,6</sup>. Also in many cases, serious consumer complaints often lead to adoption of an overkill philosophy by these companies. The company becomes so committed to rectifying the problems that cost is not given top priority. This policy leads to a higher cost of production that soon renders the product uncompetitive.

Several researchers attributed some of the problems associated with CE to the working gap between design and manufacturing engineers<sup>6,7,8</sup>. They suggested the nature of this gap must be explored and proposed some solutions for improving the environment that is necessary for CE to work. However, research shows that U.S. companies are gradually having more success in implementing the philosophy of CE into their work environment<sup>5,6</sup>.

## V. Virtual Teaming Systems

As was mentioned earlier, an increasing numbers of leading U.S. manufacturing companies are employing a variety of advanced technological innovations to enhance their position in the global market. One such technology is virtual teaming systems (VTS). VTS build on and extend the capabilities of earlier technologies known as electronic meeting systems. These systems allow virtual teams interact through their communication and data retention infrastructures. The communication infrastructure supports synchronous work and allows the team members to coordinate their asynchronous work. Synchronous work occurs when team members are working together to create the same new information at the same time and asynchronous work occurs when team members work on different information or work at different times on the information that the team is producing<sup>9</sup>. The data retention infrastructure allows the team members to share and modify information across the team. It will allow the team members to reuse the information as it is refined across the life of the project. Both of these factors enable a virtual team to work and create its products.

One widely used VTS is IPTeam Suite by Nexprise, Inc. This software supports the design and development of new products for virtual teams. It provides the communications infrastructure through its use of email, workflow routers and the use of web browsers as the primary user interface. IPTeam Suite is the data retention infrastructure for virtual teams with its virtual project areas which contain document vaults, virtual notebooks, and schedule builder. The model that IPTeam Suite uses for its environment is a project area. Physical project areas require design notebooks, document configuration control, management plans, and interactions with subcontractors and suppliers. IPTeam Suite supports all of these in a virtual environment and they can be linked together. The design process is an iterative one where choices are made. The design team must be able to record their choices and the information that was used to make that choice. Everyone on the design team must have access to the design information. When a poor choice has been made, the team must be able to backtrack and make a better one. They cannot do this without knowing the other alternatives that the team had.<sup>10</sup> Another VTS is Salvo by Simware, an exteranet application that gathers product data, applies business logic to process it, then makes this information available through browseres.<sup>11</sup>

Some leading U.S. companies are utilizing these advanced technologies with great success. For instance, Boeing has saved millions of dollars in product development of a new rocket combustion chamber by using IPTeam suite within a CE environment. Richard Baily, Vice President of the Boeing Canoga Park Facility presented the results of SLICE Program in designing a new rocket chamber at the Crossroads Conference on March 16, 1999. Nexprise IPTeam Suite was used to exchange, create and manipulate design and manufacturing information in a virtual environment. They reduced design effort period from 6-7 years to less than one year. They also reduced unit cost from \$50K to \$35K and increased producibility from 2-4 sigma to 9 sigma.<sup>9</sup> Although these technologies are becoming widely popular with industry they are still new to academe. Through a grant from the Lemelson Foundation, Manufacturing Engineering Technology Program at East Tennessee State University (ETSU) and Loyola

Marymount University (LMU) in Los Angeles, CA conducted joint product development projects with their industrial partner using IPTeam software. This pilot project which highlights benefits of using VTS is presented next.

## VI. A Pilot Project

In July 1999, a grant from Lemelson Foundation was awarded to ETSU and LMU to create an interactive virtual classroom using IPTeam software from Nexprise, Inc. Four groups of students from both universities and our industrial partner participated in this joint project. Our main goal was to introduce virtual interaction into the classroom, because virtual interactions are becoming increasingly important as separated teams jointly develop products.<sup>9</sup> We were motivated by the global outsourcing that is taking place in industry, which requires product to be designed by team members who are not co-located in the same place at the same time.

At LMU and ETSU, there is an emphasis on the classic design process. The major parts of the IPTeam software that were used are the document vault, and the notebook. Since the class schedule was fixed and there were not suppliers, the workflow and the mail portions of the environment were not used or discussed in the class. The document vault provides the configuration control of documents. Documents can be placed in the vault and then reviewed and revised by all of the members of the team. The iNotebook provides a work area that the team can use to exchange design information synchronously. The iMail and iRoute portions of the environment are used to coordinate and notify team members of new information or documentation that is available.<sup>12</sup>

IPTeam Suite supported the design and development of new products for virtual teams. It provided the communications infrastructure through its use of email, workflow routers and the use of web browsers as the primary user interface. IPTeam Suite was the data retention infrastructure for virtual teams with its virtual project areas, which contained document vaults, virtual notebooks, scheduler and consensus builder. IPTeam Suite used commercial secure servers which worked with corporate firewalls to provide security for the virtual team and its information products. Each virtual team member is authenticated before information is accessed. Since the server can be accessed across the World Wide Web with a web browser, virtual teams can be formed across corporations that are located anywhere in the world.

The virtual teams interacted through their communication and data retention infrastructures. The communication infrastructure supported synchronous work and allowed the teams to coordinate their synchronous work. Synchronous work occurred when team members were working together to create the same new information at the same time. Asynchronous work occurred when the team members worked on different information or work at different times (for the information that the team is producing). The data retention infrastructure allowed the team members to share and modify information across the team. It allowed the team members to resettle information, as it was refined across the life of the product. Both of these factors enabled a virtual team to work and create its products.

## VII. Conclusions

A manufacture's competitive advantage in an international economy is directly related to its ability to introduce new product to the market in less time and at lower cost. In this paper, the global competition and its effects on U.S. manufacturing companies and their responses were

discussed. The results of a recent national survey revealed that although U.S. consumers prefer American-made products, the uncertain economic situation forces them to buy cheaper made foreign products. This could explain the results of another survey that showed the market is flooded with imported products. However, there is a growing body of evidence that American firms are regaining their leadership role in most world markets. This could be contributed to the facts that an increasing number of U.S. companies are employing various methodologies such as CE and embracing latest technological innovations such as virtual teaming systems.

In this paper, we examined some of these technologies and their perceived benefits and also presented our own personal experience with IPTeam software in the pilot project. We believe by adopting these technologies, U.S. manufacturing companies can increase their market shares and enhance their global positions.

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